MONITORING OF IO'S VOLCANIC ACTIVITY USING GALILEO'S NEAR INFRARED MAPPING SPECTROMETER (NIMS): R. Lopes-Gautier[1], A. G. Davies[1], R. Carlson[1], W. Smythe[1] and L. Soderblom[2] ,[1]Jet Propulsion Laboratory (California Institute of Technology, Pasadena, CA 91109), [2]U.S. Geological Survey Branch of Astrogeology (2250 Gemini Drive, Flagstaff, Arizona).

One of the primary objectives of the Galileo mission is to investigate the nature of Io's dynamic volcanism. The Near Infrared Mapping Spectrometer (NIMS) is a remote sensing instrument aboard Galileo [Carlson et al. 1992] which combines imaging and spectral capabilities and is being used to find new hot spots on Io, monitor temperature changes on hot spots, and map Io's surface composition [Smythe et al. 1995; Carlson et al. 1996]. The spectral range of NIMS is from 0.7 to 5.2 microns, which spans two regions: surface reflected light and emitted thermal radiation. In this paper we present the results from the NIMS Io monitoring program during Galileo's first four orbits (G1, G2, C3, and E4).

The NIMS observations of G1 were taken on June 28 and 29, 1995; the G2 observations on September 6 and 7, 1996. Only two NIMS observations (taken on Nov. 6, 1996) were returned during the third orbit (C3), but these included the highest spatial resolution observation of Io that NIMS will obtain during Galileo's prime mission (120 km/NIMS pixel). NIMS Io data planned to be returned from the fourth orbit (E4) are eclipse observations designed to investigate the cooling and warming of hot spots as Io goes into and out of Jupiter's shadow.

NIMS Io observations during G1 detected 12 hot spots, 5 of which were not previously known to be active. Of the 7 previously known hot spots, 2 were in the vicinity of hot spots detected from ground-based studies: Hi'iaka and the 1995 outburst detected by J. Spencer [Spencer and Schneider 1996]. The other 5 known hot spots had been detected by Voyager [Pearl and Sinton, 1982; McEwen et al. 1985 and 1989]. During the second orbit (G2), NIMS found most of these hot spots to be still active, but significant changes had taken place. For example, the temperature of one of the new hot spots, Malik Patera, had increased by about 400K in the two months between the observations. A hot spot in the Volund region had cooled by over 300K during the same period. A hot spot in the Colchis region detected by Galileo SSI during the first orbit [Belton et al. 1996; and A.S. McEwen, pers. comm.] was not detected by NIMS in G2, indicating that the activity had either stopped or decreased below the NIMS detectability limit. NIMS can detect temperatures down to about 180K.

NIMS G2 observations showed several other Voyager hot spots and plume areas to be active, including Loki and Pele. Measurements from the NIMS spectra at Pele show a temperature of 828K, consistent with silicate magmas, and an quivalent disk projected area of 6.5 km^2. The coolest hot spot temperature detected by NIMS during the first two orbits is 210K.

Hot spot temperatures and areas were calculated by fitting the spectral data to a simple one-temperature black body. However, the short wavelength region of the nightside spectra for several of the hot spots shows the presence of a smaller, hot component, as is expected for an active volcanic region in which material is hotter near the vent and cools as it moves away from it. Two-temperature black body fits were done for some of the hot spots detected on Io's nightside.

Analysis of observations of Io taken in sunlight require that the hot spots' thermal signal is separated from the reflected sunlight signal. This is particularly difficult at wavelengths shorter than 3 microns, where the thermal signal from hotter silicate materials (over 1000K) peaks. A method for extracting the two types of signal from the combined spectra is currently being developed and is expected to greatly improve our analysis of dayside observations.

Apart from monitoring the temperatures and distribution of hot spots on the Io, NIMS is searching for new species on the surface and mapping the distribution of SO_2. NIMS will continue to observe Io at least once per orbit for the remainder of the Galileo mission.

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